TEMPERATE FOREST FOUNDATION
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Eco-Link

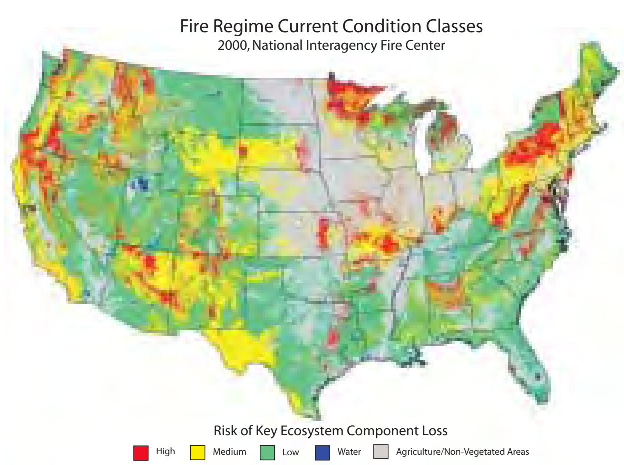
Linking Social, Economic, and Ecological Issues

Biomass for Energy
and Forest Fuel Reduction

Volume 13, Number 3

After several summers of extreme wildfire seasons in the nation's forests, the issue of how to prevent future conflagrations is on everyone's minds. In a statement to the U.S. General Accounting Office in 2002, Barry T. Hill, Director of Natural Resources and Environment said, "The most extensive and serious problem related to the health of forested lands—particularly in the interior West—is the over accumulation of vegetation, which is causing an increasing number of large, intense, uncontrollable, and destructive wildfires." (pg. 2)

Buildup of biomass is a forest health issue that needs to be addressed to mitigate future risk to the nation's forestland. The prevailing option is to reduce forest fuel loads that contribute to the catastrophic nature of forest fires especially in the wildland/urban interface. Such treatments help return forests to a more fire-tolerant condition by removing excess fuels and introducing prescribed fire when conditions allow low-intensity burns. Although treatment approaches are fairly well known for most conditions, treatment is often absent because of numerous hurdles that make treatment uneconomical.



BioPower—the use of organic matter for power and fuel—offers a solution to the problem of excess biomass while also offering benefits in the form of environmentally sound, rural economic growth, and national energy security benefits. Currently, 80% of the country's energy is supplied by fossil fuels, which are finite and nonrenewable. As a renewable energy source, BioPower produces fewer emissions than conventional sources and can actually improve environmental quality by offsetting fossil fuel use and related emissions and by using wastes that are creating land use problems. BioPower growth can also create new markets and employment for farmers and forest workers, many of whom currently face economic hardship. It can establish new processing, distribution, and service industries in rural communities.

Advantages of Biomass Fuel

According to the U.S. Department of Energy's National Renewable Energy Laboratory (NREL), the majority of biomass energy is produced from wood and wood wastes (64 percent), followed by municipal solid waste (24 percent), agricultural waste (5 percent) and landfill gases (5 percent). [1998] Wood fuel has several environmental advantages compared with fossil fuels:

Renewability: Wood from sustainably managed forests can be replenished continuously, leading to a plentiful and dependable supply.

Carbon emissions: Because trees store carbon as a result of photosynthesis, there is no net production of carbon dioxide (CO_2), the major greenhouse gas, from wood combustion. The CO_2 generated during combustion of the wood equals the CO_2 consumed during the lifecycle of the tree.

Heavy metals and sulfur: Wood fuel does not contain sulfur or heavy metals; reducing the threat of acid rain pollution. Wood does, however, contains sulfur and nitrogen, which yield SO_2 and NO_x in the combustion process. However, the rate of emissions is significantly lower than that of coal-based generation.

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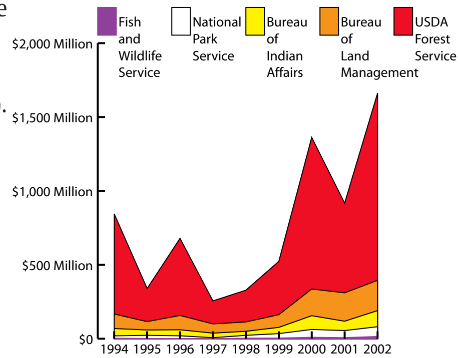
Fire and Forest Health

The ecological consequences of the U.S. government's past policy of fire suppression have become evident, in recent years, in the large number of catastrophic wildfires. Federal wildfire suppression costs exceeded $1.6 billion in 2002. (Contrast this with the annual average $657 million spent on fire suppression by federal agencies between 1994 and 2001.) After the wildfire season of 2000, the President requested a national strategy for preventing the loss of life, natural resources, private property, and livelihoods in the wildland/urban interface. Working with Congress, the Secretaries of Agriculture and Interior jointly developed the National Fire Plan (NFP). One of the five key points of the plan was reduction of hazardous fuels.



U.S. Fire Suppression Costs (1994-2002)
Source: National Interagency Fire Center (NIFC)

Fire has historically shaped millions of acres of forest in North America. Natural fire regimes were altered throughout the 20th century by the U.S. government's policy of fire suppression which extinguished most fire in the forest. As a result, forestlands underwent a long, slow buildup of woody biomass becoming denser and overgrown. Trees had to compete for resources and became more unhealthy and prone to insects and disease. With more living and dead fuels present, both in larger landscape patches and in the vertical structure of the forest, any ignition in dry weather, such as those of the past few years, is likely to result in a wildfire that behaves so violently that suppression may be impossible.

Options for biomass utilization:

Use in conventional wood products

Pulp and Paper use

Composite wood products

Inclusion in plastics, cements, etc.

Bioenergy

There are many options for dealing with excess forest fuels: prescribed burning, thinning, and harvesting to name a few. Environmental, economic, and social considerations will dictate how we ultimately deal with this biomass, whether we leave it, dispose of it, or utilize it. Any solution, however, should incorporate bioenergy. Biomass power is the most non-discriminating use of wood. It supplements any forest products uses by generating energy from by-products and what would otherwise be waste. Incorporating bioenergy into forest fuel reduction furthers complete resource utilization for the benefit of producers, consumers, and the environment.

Bioenergy Basics

Bioenergy is the use of organic matter—such as wood, plants, residue from agriculture or forestry, and the organic component of municipal and industrial wastes—to provide heat, make fuels, and generate electricity. Wood, the largest source of bioenergy, has been used to provide heat for thousands of years. In addition to heating, biomass can be used, like fossil fuels, to power automotive vehicles and generate electricity. Modern technology is working to improve the efficiency of bioenergy production to increase its marketability. The two leading options for converting large amounts of biomass in the U.S. to energy are conversion of biomass to electricity and conversion of biomass to liquid fuels.

U.S. plants, mostly in the pulp and paper industry, use biomass to generate more than 7,500 megawatts of electricity for their own use and for sale back to utilities. The Department of Energy, Office of Energy Efficiency and Renewable Energy BioPower Website reports, "Recent studies indicate that quantities of available (presently unused) mill and urban wood residues exceed 39 million dry tons per year in the U.S.—enough to supply more than 7,500 MW of new BioPower, or a doubling of the existing biopower capacity in the U.S."

Most of today's biopower plants operate in ways similar to most fossil-fuel fired power plants. The biomass fuel is burned in a boiler to produce high-pressure steam. This steam is introduced into a steam turbine, where it flows over a series of aerodynamic turbine blades, causing the turbine to rotate. The turbine is connected to an electric generator, so as the steam flow causes the turbine to rotate, the electric generator turns and electricity is produced. Research into new technology is working towards making energy conversions more efficient and bringing the implementation costs as well as the return on investment to competitive levels with existing energy systems. New energy developments are examined on the next page.

Biomass can be also be converted directly into liquid fuels like ethanol and biodiesel for our transportation needs. Ethanol, an alcohol, is made by fermenting any biomass high in carbohydrates, like corn, through a process similar to brewing beer. It is mostly used as a fuel additive to cut down a vehicle's carbon monoxide and other smog-causing emissions. Biodiesel, an ester, is made using vegetable oils, animal fats, algae, or even recycled cooking greases. It can be used as a diesel additive to reduce vehicle emissions or in its pure form to fuel a vehicle.

New technology could lead to using biobased chemicals and materials to make products such as anti-freeze, plastics, and personal care items that are now made from petroleum. In some cases these products may be completely biodegradable. Technology to bring biobased chemicals and materials to market is still under development.

Biopower Systems

After hydroelectric, biopower provides the most renewable energy in the U.S., contributing over 1.5% of total electricity supply. This compares to 0.4% for geothermal, and 0.1% for wind and solar combined. There are essentially two kinds of biopower—biopower for self-generation in pulp and paper facilities, and biopower facilities that produce power and heat not only for the on-site facility, but also for the grid.

Almost two-thirds of all biomass energy in the U.S. goes to providing heat and power for industrial facilities, the pulp and paper industry in particular. Less than a fifth of all biomass is consumed for electricity production, with a portion of this—7,000 of 10,000 megawatts (MW) in total biopower capacity installed nationwide—consumed by pulp and paper operations. Much of this biopower capacity in the U.S. came on-line in the 1980s in response to the Public Utilities Regulatory Policy Act of 1978 (PURPA), which guaranteed a market and favorable prices to certain non-utility power producers.

While steam generation technology is very dependable and proven, its efficiency is limited. Direct-fired biomass power boilers are typically in the 20-50 MW range, compared to coal-fired plants in the 100-1500 MW range. The small capacity plants tend to be lower in efficiency because of economic trade-offs; efficiency-enhancing equipment cannot pay for itself in small plants. Although techniques exist to push biomass steam generation efficiency over 40%, actual plant efficiencies are in the low 20% range. There are four primary classes of biopower systems: direct-fired, cofired, gasification, and modular systems.

Cofiring

Cofiring is a more economic way to transition to biopower involving substituting biomass for a portion of coal in an existing power plant furnace. Because much of the existing power plant equipment can be used without major modifications, cofiring is far less expensive than building a new biopower plant. After "tuning" the boiler for peak performance, there is little or no loss in efficiency from adding biomass. This allows the energy in biomass to be converted to electricity with the high efficiency (in the 33-37% range) of a modern coal-fired power plant.

Biomass Gasifiers

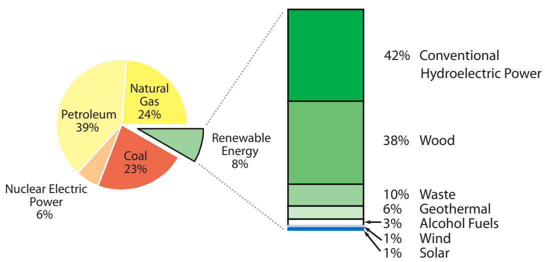
Biomass gasifiers operate by heating biomass in an environment where the solid biomass breaks down to form a flammable gas (a mixture of hydrogen, carbon monoxide, and methane). This offers advantages over directly burning the biomass. The biogas can be cleaned and filtered to remove problem chemical compounds. The gas can be used in more efficient power generation systems called combined-cycles, which combine gas turbines and steam turbines to produce electricity. The efficiency of these systems can reach 60%.

Gasification systems will be coupled with fuel cell systems for future applications. Fuel cells convert hydrogen gas to electricity (and heat) using an electro-chemical process. There are very little air emissions and the primary exhaust is water vapor. As the costs of fuel cells and biomass gasifiers come down, these systems will proliferate.

Modular Systems

Modular systems employ some of the same technologies mentioned above, but on a smaller scale that is more applicable to villages, farms, and small industry. These systems are now under development and could be most useful in remote areas where biomass is abundant and electricity is scarce. There are many opportunities for these systems in developing countries.

Renewable Energy as Share of Total Energy 2001, Energy Information Administration



Summary

Bioenergy is an environmental energy alternative to fossil fuels and may be the key to helping reduce fire danger in the nation's forests. However, several obstacles must be successfully addressed before biomass energy can become viable. First, to make biomass fuel delivery feasible, forest managers must have a viable market within reasonable distance that pays an adequate price. Second, to assure payback of large initial investments, investors in energy production facilities must have a reliable fuel source at prices that allow competitive production over a long enough period. Today, neither of these situations exists. The use of biomass for energy will always be the lowest-value use. Small-diameter or other or non-traditional wood products will out-bid the energy industry for the biomass supply. The biomass energy market, however, can provide a way of disposing of otherwise problematic residual material in a least-cost, if not profitable, manner.

Glossary of Terms

Biomass
Organic matter such as wood, plants, residue from agriculture or forestry, and the organic component of municipal and industrial waste.

Black liquor
Spent liquor from the pulping process which can be recovered to be reconstituted into cooking chemicals.

Closed-Loop Process
A closed-loop process is defined as a process in which power is generated using feedstocks that are grown specifically for the purpose of energy production.

Current Condition Classes
Current Condition Classes are the relative risk of losing one or more components that define an ecological system based on the qualitative measure of the degree of departure from Historical Natural Fire Regimes resulting in alterations of key ecosystem components such as: species composition, structural stage, stand age, canopy closure, and fuel loadings. [NIFC]

Disturbance
A discrete event, either natural or human-induced, that causes a change in the existing condition of an ecological system.

Fuel Loading
The accumulation of combustible materials such as underbrush, grass, sticks, and trees in an area.

Integrated Mill
A mill that makes its own pulp from which it then produces paper.

Forest Health
Forest health is defined by the US Forest Service as; a condition wherein a forest has the capacity across the landscape for renewal, for recovery from a wide range of disturbances, and for retention of its ecological resiliency while meeting current and future needs of people for desired levels of values, uses, products, and services.

Public Utility Regulatory Policies Act of 1978 (PURPA)
A US federal law enacted in 1978 which was intended to encourage more energy-efficient and environmentally friendly commercial energy production. PURPA defined a new class of energy producer called a qualifying facility. QFs are either small-scale producers of commercial energy who normally self-generate energy for their own needs but may have occasional or frequent surplus energy, or incidental producers who happen to generate usable electric energy as a by-product of other activities. When a facility of this type meets the Federal Energy Regulatory Commission's requirements for ownership, size and efficiency, utility companies are obliged to purchase energy from these facilities based on a pricing structure referred to as avoided cost rates. These rates tend to be highly favorable to the producer, and are intended to encourage more production of this type of energy as a means of reducing emissions and dependence on other sources of energy.

Salvage Logging
Logging that involves harvesting only dead or dying timber.

Wildland/urban interface
The line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels .

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More Info

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http://www.biomass.org/

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US Department of Energy
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U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy
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http://www.eere.energy.gov/biopower/main.html

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http://www.eere.energy.gov/biopower/bplib/library/

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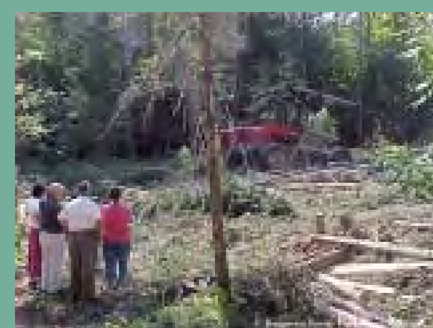

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